

INVESTIGATION OF HEAD BURNS IN ADULT SALMONIDS

PHASE 1: EXAMINATION OF FISH AT LOWER GRANITE DAM, JULY 2, 1996

FINAL REPORT

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SECTIOS 1

ISTRODCCTION

“Head burn” is a descriptive clinical term used by fishery biologists to describe exfoliation of skin and underlying connective tissue of the jaw and cranial region of salmonids, observed at fish passage facilities on the Columbia and Snake Rivers. The observations are usually made on upstream migrant adult salmon or steelhead. Past observations have suggested that the incidence of head burns is associated with high river flow conditions or spillway discharges from dams, but the etiology of head burns has not been investigated in detail. An expert panel, convened in 1996, to evaluate the risk and severity of gas bubble disease (GBD) in the Snake and Columbia River system believed that, while head burns appeared to be distinct from GBD, the relationship between dissolved gas saturation in the rivers and head burns was uncertain.

In June 1996, National Marine Fisheries Service (NMFS) biologists reported observations of head burn in adult salmonids at the Lower Granite Dam fish passage facility. Given the uncertain etiology of this condition, the question of their cause was once again highlighted. While there has been no additional evidence to link head burns with high dissolved gas saturation, the elevated total dissolved gas (TDG) levels in the Snake and Columbia Rivers in spring 1996 runoff at the time head burns were observed raised the question of a possible link between the lesions and high dissolved gas. Alternatively, head burns may represent primary abrasive lesions that proceed to a variety of outcomes. Additionally, gas bubbles forming under the skin of fish, resulting from excess TDG, could exacerbate the tendency for abrasions to occur.

As a result of the observations of head burns in spring 1996 and their uncertain etiology, this project was rapidly implemented in order to examine adult fish at the Lower Granite Dam fish passage facility.

The term “gas bubble disease” is retained in this report. Recent usage has included “gas bubble trauma” to describe conditions and consequences of gas supersaturation exposures in fish. However, since gas supersaturation exposure to fish results in a complex series of physiological events and responses, gas bubble disease is a more accurate descriptor.

SECTION 2

APPROACH

Adult salmonids, primarily chinook salmon (*Oncorhynchus tshawytscha*) were examined at the Lower Granite Dam adult fish trap facility on July 2, 1996. The examination team consisted of Dr. Ralph Elston, Aquatechnics Inc. and Dr. Warren Groberg, Oregon Department of Fish and Wildlife. Mr. Jerry Harmon of the NMFS, Mr. Dennis Coleman of the U.S. Army Corps of Engineers and other fisheries staff were also present.

A group of upstream migrant fish had accumulated in the collection facility for about 12 hours prior to the examination. Seven of these fish were examined grossly while under anesthesia and prior to release. In addition, approximately 15 adult chinook salmon, Rapid River stock, had been held for transport to the Looking Glass Hatchery for approximately 36 hours. These fish were observed as the tank was dewatered and the fish were loaded into the transport vehicle. Two Rapid River stock chinook salmon with the head burn condition had been held separately for about 36 hours. These fish were killed with an overdose of anesthesia (200 ppm Ms-222) and examined at necropsy.

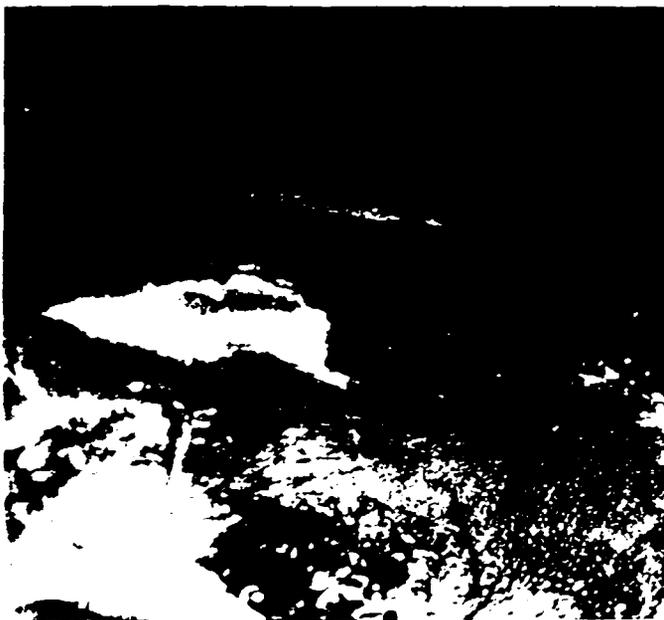
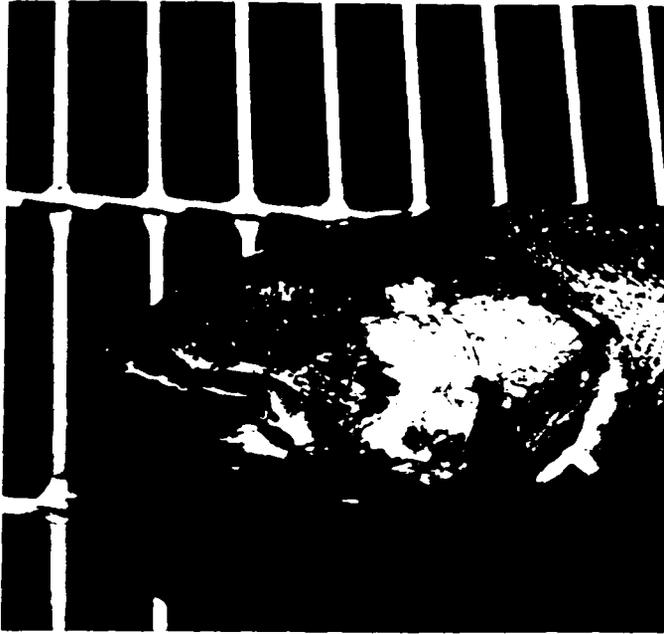
Lesions from released and necropsied fish were examined in detail and photographed. External body surfaces were examined for acute, chronic and residual lesions that could indicate gas supersaturation exposure. At necropsy, fish body length and girth were measured, and wet preparations of gill tissue were examined microscopically for gas emboli (Montgomery Watson 1996). Internal organs and mesenteries were examined for the presence of gas bubbles and other lesions. Representative skin and scar tissue from the heads of two fish was excised and fixed in Davidson's fixative for possible later histological examination.

SECTION 3

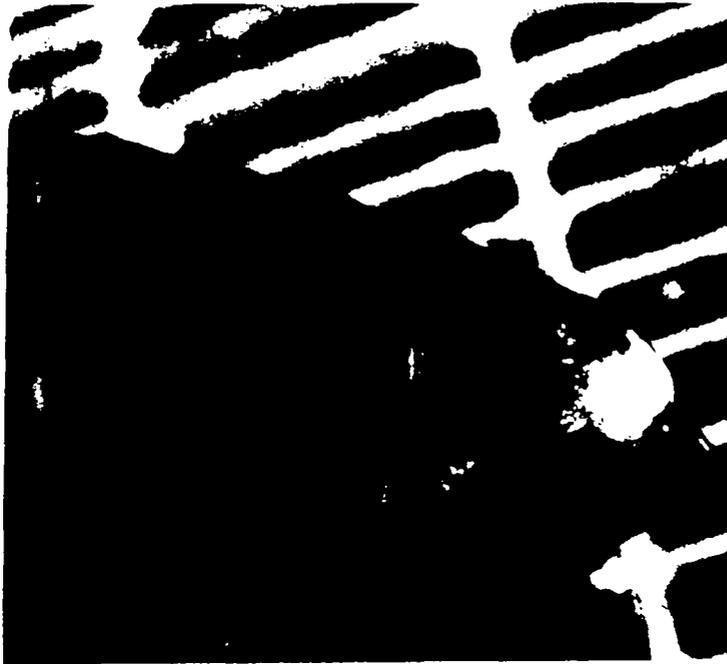
RESULTS

Accumulated Upstream Migrant Fish. Three of seven fish had exfoliated areas of skin on the head. These lesions were acute and unhealed (Figs. 1 and 2). In two cases **longitudinal** abrasive marks were observed at the posterior aspect of the lesions on the lower jaw or dorsal aspect of the head (Figs. 3 and 4). The leading edges of the pelvic, pectoral and dorsal fins on these fish were variably rough and did not appear to be mucus coated (Fig. 5). Leading edges of the fins of fish without acute abrasions were variably smooth and mucus coated to rough and relatively dry. There were no grossly observable gas bubbles on external body surfaces, in the oral cavity, within the eyes or in the fins of these fish. The fins appeared clear and without inter-ray inflammation.

Necropsy of Two Rapid River Fish. The necropsy records for these fish are contained in the Appendix of this report. One fish had extensive areas on the top of the head that appeared to be newly healed skin as well as skin exfoliation near the eye and on the snout (Fig. 6). The other fish had more extensive areas of skin exfoliation and no healed areas (Figs. 1 and 2). Both fish had what appeared to be abrasion marks or scratches on the posterior aspect of the unhealed lesions. These were aligned along the longitudinal axis of the fish. The leading edges of the pectoral, pelvic and dorsal fins on both fish were rough to the feel and in one fish had a white appearance. Like the fish examined live, there were no **grossly visible gas** bubbles in these fish. No bubbles were observed in the visceral organs. The inter-ray tissue on fins of both fish was clear.



Figures 1 to 4. Figs. 1 and 2 (upper left and right) show typical unhealed lesions with trailing abrasive marks as observed in the Rapid River chinook salmon. Figs. 3 and 4 show higher magnification views of the trailing abrasive marks observed on the operculum and head of the salmon. The head of the fish is to the left in these photographs.



Figs. 5 and 6. Fig. 5 shows extensive healing on the lateral and dorsal aspects of the head of a Rapid River chinook salmon. The healed areas are a dark green in contrast to the older skin seen on the back of the fish. Fig. 6 shows the abraded leading edge of the dorsal fin of a Rapid River chinook salmon.

Rapid River Fish Held For Transport. These fish were observed as their tank was dewatered and the fish were loaded to the transport truck. Fish were not handled in order to minimize pre-transport stress. One of approximately fifteen fish had white discolored patches on the head, believed to represent skin exfoliation.

SECTION 4

DISCUSSION AND RECOMMENDATIONS

The loss of skin on the head and jaw region of fish examined in this study, the associated trailing abrasive marks on the skin and the loss of mucus and skin on the leading edge of the fins indicate mechanical lesions, possibly resulting from contact with hard material such as concrete. This pattern of trailing abrasive marks associated with the cranial lesions and the loss of mucus on leading edges of fins suggests the mechanical damage occurred when the fish swam or was pushed forward into a rough abrasive structure. Such lesions might result from either passage through a narrow aperture or under turbulent current conditions that forced the fish laterally into a hard, abrasive structure while swimming forward.

The healed lesions observed in one of the necropsied fish indicate a marked repair capacity for exfoliated skin areas. The extent of the repaired area suggested that days to weeks had passed since the lesion preceding the repair occurred in this fish. The cause of the skin loss in this fish could not be determined since the initiating lesion was healed. Thus, neither mechanical trauma or GBD can be ruled out as causing the lesion. While the lesion could have been mechanical in origin, gas accumulations are known to occur sub-epidermally in adult salmonids exposed to gas supersaturation, resulting in raised bubble lesions. Such lesions have previously been reported in the oral cavity and on external surfaces of the head.

There were no signs of acute gas bubble disease (GBD) observed in the study fish. Gas emboli were not observed in the gills, and no gas bubble accumulation was noted on external skin surfaces or in the eyes. Gas bubbles are known to accumulate on external body surfaces, often on the head and in the oral cavity in adult salmonids exposed to high gas supersaturation concentrations but such lesions were not found in these fish. Inter-ray inflammation can be a residual sign of previous gas emboli and connective tissue bubbles (Montgomery Watson 1995) but such inflammation was also not observed grossly in fish examined in this study. However, staff at the Lower Granite fish passage facility (personal communication, Mr. Jerry Harmon) reported that several adult fish with distinct bubbles on the external surface of the head and other body locations were observed about two to three weeks prior to this examination.

The unhealed lesions examined in this study most likely resulted from abrasions, but there was not gross observable evidence regarding etiology of the healed lesion seen on one fish. Based on the examinations made for this study, no evidence of gas bubble disease was found.

If high flows and/or resulting high gas supersaturation concentrations occur in 1997 or subsequent years, examination of adult fish at this facility earlier in the run should be considered. A collective discussion and analysis by facility staff and experts, regarding locations where abrasions like those found in this study could occur, may be useful. If fish

are evaluated in subsequent years. it would also be useful to include a range of clinical examinations for GBD (for bubbles in fin vasculature or connective tissue, residual lesions of GBD in the fins and vascular emboli in the gills) in order to more definitively include or exclude GBD as a causative factor in head burns.

SECTION 5

REFERENCES CITED

Montgomery Watson 1995. ***Allowable Gas Supersaturation of Fish Passing Hydroelectric Dams. Task 8 - Bubble Reabsorption in a Simulated Smolt Bypass System - Concept Assessment.*** Final Report. Prepared for Bonneville Power Administration, Portland, Oregon. Project Number 93-8. Contract Number DE-AC79-93BP66208.

Montgomery Watson 1996. ***Allowable Gas Supersaturation of Fish Passing Hydroelectric Dams. Task 10 - Examination of Hatchery Steelhead Gills for Gas Emboli Using Compound Microscopy and Examination for Additional Signs of Gas Bubble Disease.*** Draft Report, Prepared for Bonneville Power Administration, Portland, Oregon, Project Number 93-8, Contract Number DE-AC79-93BP66208.

APPENDIX

NECROPSY DATA SHEETS

SECROPSY RECORD

Project Name: Etiology of Head Burns in Adult Salmonids

Date: July 2, 1996

Examiners: Ralph Elston and Warren Groberg

Sample Location: Upstream adult fish collection facility. Lower Granite Dam. Snake River. Washington

Individual Fish ID or Reference Number: Necropsy Fish 2.

Species: Chinook salmon. *Oncorhynchus tshawytscha*

Sex: Female

Standard Length: 665 mm Girth: 315 mm

Description of condition, grossly observable lesions:

Exfoliated skin areas and ulceration:

Left side of head extensive from snout to operculum. about 6 cm long, 3 cm width at front. 5 cm wide at operculum.

Right side of head. upper and lower jaw with abrasion and longitudinal abrasion marks. particularly in lower jaw.

Leading edge of fins rough and granular feel, visible loss of pigmented skin.

Wet mount examination: No gas emboli found in gills.

Samples taken:

Histo: 18-4 Left operculum. ulcer/normal skin; 18-5 abrasion mark skin strip: 18-6 abrasion mark skin strip.

Bacti: _____

Virology: _____

Chemistry: _____